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PRINCE WILLIAM SOUND MANAGEMENT AREA

HERRING REPORT

TO THE ALASKA BOARD OF FISHERIES

By:

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INTRODUCTION

The Prince William Sound (PWS) herring management area encompasses all coastal waters of the Gulf of Alaska between Cape Suckling and Cape Fairfield, extending offshore to 59° N. latitude. Five herring fisheries occur during the year.

During the spring season, two fisheries target herring for sac roe using either seine or gillnet gear. Two spawn-on-kelp fisheries harvest either naturally occurring spawn on kelp or spawn on kelp suspended in pounds. In the fall a food-and-bait fishery occurs. Of the five herring fisheries only the wild spawn-on-kelp and the food-and-bait fishery are open entry fisheries.

For management purposes, all herring fisheries target on what is treated as a single major stock of herring that spawns during the mid-April to early May period. At the 1994 Board of Fisheries meeting in Cordova, the minimum spawning biomass threshold was raised from 8,400 to 22,000 tons for the PWS stock. No fishery may be opened if the estimated spawning biomass is below this level. The 22,000 ton threshold is 25 percent of the potential spawning biomass from an unfished stock. The higher threshold will establish manageable harvest levels while reducing the risk of driving the population to low abundance through overfishing. When the stock size is between 22,000 and 42,500 tons, the PWS Herring Management Plan (5 AAC 27.365) allocates the projected available surplus to the five fisheries based on a 0 to 20 percent harvest rate. The maximum harvest rate of 20 percent is applied when stock size is greater than 42,500 tons. The sac roe seine fishery is allocated 58.1 percent of the available surplus; the food and bait fishery 16.3 percent; the pound spawn-on-kelp fishery 14.2 percent; the wild spawn-on-kelp fishery 8.0 percent; and the gillnet sac roe fishery is allocated 3.4 percent.

The 1996 spawning biomass was projected to be 24,000 tons and be dominated by age-8 fish from the 1988 year class. The projected spawning biomass was above the minimum threshold needed for a fishery, however spring fisheries were canceled in 1996 due to the projected age structure of the population, the relatively low stock abundance, and the rebuilding nature of the PWS stock. The conservative approach adopted by the department was based, in part, on the forecast's reliance on age-8 herring as the dominant year class for the stock. The older age classes of PWS herring have seen higher than normal mortality rates in recent years. The higher mortalities were principally due to the effects of Viral Hemorrhagic Septicemia Virus (VHSV) and the fungus *Icthyophonus hoferi.* Both of these diseases had reached epidemic proportions in the PWS stock and appear to have been instrumental in the stock's crash. The PWS herring stock suffered a dramatic decline from 140,000 tons in the 1991-1992 herring year to 18,800 tons by the 1993-1994 herring year. While the stock's dramatic decline appeared to have bottomed out by the fall of 1995, high over-winter mortality in older aged herring was still expected to drive the spawning biomass below or very close to the 22,000 ton minimum threshold prior to the 1996 spring fisheries. For this reason, spring herring fisheries were canceled for 1996 (Table 1).

A summary of the major spawning areas and the timing of spawn from 1994-1996 are shown in Figures 1-3. Historic fishery harvest values are presented in Table 2. The 1996-1997 food-and-bait fishery harvested 933 tons, valued at $0.19 million, setting the average earnings of the 12 permit holders who participated at $15,555.

1996 Season Summary

In January, the department released an announcement canceling all spring herring fisheries. Aerial surveys were then conducted from April 1 through April 24 to estimate biomass and document spawning activity. The peak aerial estimate for 1996 was 10,600 tons, an increase of 1,200 tons from 1995. The biomass was distributed as follows: the Southeast Shore area had 200 tons; the Northeast Shore area had 1,000 tons; and the Montague Island area had 9,400 tons. No spawning activity was observed on Naked Island or in the North Shore area. There is a recognized imprecision in estimating biomass using aerial surveys, primarily because not all herring are visible from the air at times. This is especially true in the Montague Island area where a majority of the PWS spawning biomass has been located in recent years.

The spawning biomass of herring was again dominated by the 1988 year class. Age composition data indicated that over half the biomass was age-8 and older. In addition, there was a reasonable showing of age-3 and age-4 recruits. There were few age-6 and age-7 herring in the samples with these ages comprising approximately 12 percent of the population by number. Although three year old herring are not fully recruited to the fishery, strong showings of age-3 herring were seen in a number of the Montague Island samples collected this spring which is an improvement over the past few years. The majority of the spawning biomass in 1997 will continue to be from the 1988 brood year. However increasing natural mortality will continue to diminish the contributions made from this year class.

Approximately 27 miles of shoreline received spawn in 1996, an increase over the 1995 estimate of 21 miles. The majority of spawn (54%) occurred around Montague Island. Preliminary reports from the spawn deposition survey indicate that spawn was spotty, with the highest concentration of eggs in Rocky Bay. As in 1995, the spawn density was low. The 1996 spawning surveys saw a small (15%) increase in the number of eggs per square meter over the 1995 survey.

Based upon the preliminary spawn deposition results, the increases in the aerial biomass estimates, the miles of spawn, and the mile-days of spawning activity, the 1996 spawning biomass had clearly risen above 1995's biomass of 20,600 tons and was close to the preseason forecast of 24,000 tons. Based on the age structure of the population seen in the spring, the biomass is forecasted to increase to 37,598 tons in 1997 (Figure 4). The age structured model forecasts and hindcasts stock size using aerial biomass, miles of milt, spawn deposition and age composition.

VHSV and *Icthyophonus*

As part of a continuation of studies begun in 1993, herring were collected from prespawning, spawning and post spawning aggregations for pathological examination to determine the prevalence of VHSV and/or *Icthyophonus* in the population. During the course of sampling, skin hemorrhages associated with Icthyophonus were observed on about five percent of prespawning herring. None were detected on the spawning and post spawning populations. Tissue samples were sent to the pathology lab in Juneau and VHSV was again identified in the PWS population. Overall, studies are indicating that VHSV appears to be returning to background levels within the PWS population and *Icthyophonus* appears to also be on the decline.

In addition to tracking the course of the disease outbreaks within the PWS population through time, researchers have been conducting experiments to confirm what types of causative factors might trigger an epizootic event where a significant percentage of the population begins to express symptoms of the disease. The research, funded by the Exxon Valdez Oil Spill Trustee Council, has clearly identified that when subjected to stress, herring with latent VHSV will begin to express symptoms of the disease. Laboratory experiments have shown that chemical stress such as exposure to oil, biological stress such as the presence of other diseases or parasites, or physiological stress such as capture or confinement have all resulted in VHSV outbreaks. Additional studies have confirmed that the virus is actively shed by diseased fish and can be detected in the water around a newly infected fish within 48 hours of infection. The results of the ongoing disease studies, while still preliminary and in need of follow-up research, have alerted the department that current practices within specific herring fisheries may be exacerbating the disease outbreaks being experienced by the PWS herring population.

Sac Roe Seine Fishery

There are 103 permanent and 2 interim purse seine permits in Prince William Sound. Purse seines can be 150 fathoms in length and 1000 meshes deep. Mesh size is not regulated. The historic seine sac roe harvest is given in Table 3. The management goal for sac roe fisheries is to enhance the value of the harvest by providing a high quality product to the industry. Quality for PWS is roughly defined as an average fish size of 120 grams or larger and a mature roe recovery of 10 percent or greater. Generally, to obtain the highest quality sac roe from the spawning biomass requires a rigorous sampling program. Sampling is organized by the department with the cooperation of seiners and processors. Sampling helps to identify locations with a large, average fish size. Sampling also estimates the mature roe percentage and helps to identify when roe recovery is expected to be near optimum. Unfortunately, the repeated capturing, crowding, and releasing of fish during daily sampling efforts may be an added stress that contributes to outbreaks of VHSV and results in unintended high mortalities. The department intends to modify it's sampling design and sampling protocols to minimize unnecessary stress on the prespawning population. Oversampling the same isolated groups of fish, or impounding tens of tons of herring to collect a small sample have become routine practices for the department and the industry. During prolonged fisheries, pursed seine sets have been held for hours only to be released after the maturity or size was determined to be to low. From the ongoing disease research, it appears that these practices may come with significant costs to the herring population that reaches beyond simply those fish who were subjected to the handling stress.

Gillnet Sac Roe Fishery

There are 24 herring gillnet permits in Prince William Sound. Gillnets are limited to 100 fathoms in aggregate length and 120 meshes in depth. Mesh size is regulated to a minimum of 2 1/8 to a maximum of 3 inches. The historic gillnet sac roe harvest is given in Table 3. Quality is a primary consideration for the gillnet sac roe fishery. As in the seine fishery, test fishing occurs to identify an area with large herring and a high roe maturity percentage. Gillnets are more selective for larger size fish than are seines and the boats can fish in smaller areas. Therefore, targeting the gillnet fleet on concentrations of high quality herring is easier to achieve than with the seine fleet.

Pound Spawn-On-Kelp Fishery

There are 128 herring pound permits in Prince William Sound. Seine specifications for the pound fishery are the same as for the seine sac roe fishery. In 1994, the Board of Fish allowed open pounding as a legal gear type. The Board provided the department leeway in managing for open or closed pounding, either separately or in combination. The Board also allowed four permit holders to operate together in a pound, and limited the size of closed pounds to 2,000 square feet at the surface. Walls of a closed pound may not exceed 30 feet in depth. Because of the low stock abundance since 1993, these regulations have yet to have an influence on the fishery. When a fishery does occur, the entire gear group's herring quota is divided by the number of permits to determine the herring quota for each permit. The department also establishes the maximum number of blades of kelp that a person may maintain in the pound while fishing. A Commissioner's permit is no longer required to participate in the fishery. The historic pound fishery harvest is given in Table 4.

The pound spawn-on-kelp fishery is unique when compared to other herring fisheries. Participants import *Macrocystis* kelp from Southeast Alaska as a substrate for herring to spawn upon, although local kelp such as *Laminaria* is also authorized for this same use. The blades of kelp are individually hung on lines near the surface of the pound. For closed pounding, mature herring are captured by purse seine and transferred into the pound structure where they may be held for up to eight days. After herring and kelp are introduced into the pound, spawning hopefully occurs and the spawn-on-kelp is then harvested. When open pounding, kelp is suspended in the water and the open pound structure is moved into position near active spawning. The pound spawn-on-kelp fishery is usually the first spring herring fishery to open. The opening occurs after an adequate biomass has been sighted and sample results indicate mature fish are available. In 1996, aerial surveys in early April documented little herring biomass or spawning activity in the traditional pounding location of northeast PWS. Between April 12 and May 5, only 10.0 shoreline miles of spawn were observed in the Northeast Shore Area (Figure 3). The peak aerial survey estimate for the same area was 1,085 tons.

The Prince William Sound Herring Management Plan allocates 14.2% of the guideline harvest of herring to the pound fishery. Allocation of the harvest guideline is based on the goal of one ton of spawn-on-kelp product for every 12.5 tons of herring allocated to this fishery. That harvest quota is then distributed to each individual permit holders by a specified number of kelp blades. In 1991 the Board of Fisheries directed the department to limit the number of kelp blades that can be utilized by each permit holder. This action was an indirect step taken to help reduce the overutilization of the resource by the herring pound fishery. Despite the kelp blade limit, the potential for overharvesting the herring quota remains high. There is no definitive measure of assessing the actual tonnage of herring introduced into a closed pound short of removing, killing and weighing the herring from a pound. Citations have been issued for having introduced tons of herring far in excess of the allowable quota into pounds, during both the PWS and Craig/Klawok pound fisheries. These types of citations have been repeatedly dismissed in court because of the recognized lack of an accurate, harmless method to estimate the number of tons of herring introduced into a pound. The departments only true measure is to remove and weigh all herring from the pound

Occasionally, the technique of crowding herring into pounds at extremely high densities has successfully been used to produce high quality roe-on-kelp. Crowding has also been identified as being able to induce

VHSV outbreaks in fish subjected to this stress. Once released, infected fish have the potential to transmit the virus to a broader segment of the population. While the department routinely considers herring utilized in closed pounds as having been permanently removed from the population, the true loss to the population may extend well beyond the tons of herring placed into pounds.

Wild Spawn-On Kelp Harvest

The wild spawn-on-kelp fishery, utilizing native Prince William Sound kelp, occurs after a major spawning event takes place on marketable species of kelp. Wild spawn on kelp is taken by divers or by hand picking, depending upon the type of kelp available for harvest and the market demand. The historic wild spawn-on-kelp fishery harvest is given in Table 5.

The 1991 fishery was the first year *Fucus* kelp (popweed) was the species in demand in Prince William Sound. Generally, a survey of processors takes place before the season to determine the market for both *Fucus* and ribbon kelp. *Fucus* kelp, a predominately intertidal species, doesn't always occur in harvestable quantities with the traditional subtidal kelp species (ribbon, sieve, and hair kelp). Given adequate spawning, openings in two different areas to harvest both *Fucus* and the traditional species of kelp may occur. This harvest strategy would satisfy market demand for both types of kelp. Of continued concern to the department is the waste of harvested but unsold product. Waste has resulted from too large a number of harvesters participating, a high number of new participants each year, and remote harvest locations. Some trimming is traditional to enhance product salability and all product harvested but not sold must be reported on fish tickets by the buyer and seller. Waste of this type is most easily reduced through market pressures stressing quality on all harvesters. Wild spawn on kelp is also taken by subsistence users in Prince William Sound.

Food-and Bait Fishery

The food-and-bait season may run from October 1 through January 31, however industry concerns over product quality usually result in a delay of the season's opening date. Flesh oil-content and subsequent bait quality improves into the fall and winter months. Larger fish begin to show and become vulnerable to purse seine gear later in the fall as well. Market demand for bait is generally from crab and longline fisheries. Purse seine size is not restricted for the food-and-bait fishery, and trawling or gillnetting may also occur. The historic food-and-bait fishery harvest is given in Table 6.

1996-1997 Food-and Bait Fishery

The Prince William Sound food-and-bait herring season opened by emergency order at noon on November 1, 1996. The four participating processors and interested fishermen were canvassed and all preferred to postpone the October 1 opening date for one month. The fishery took place in the Montague Island area between November 1 and November 3. This is the fifth year the fleet has fished the Montague/Green Island area. The food-and-bait harvest has previously taken place around the Knowles Head area in eastern PWS. The last few years have seen a majority of the older and larger herring in PWS schooling in the Montague Island. This area continues to have best potential of producing a catch of the highest quality. Waters in PWS outside of the Montague District and east of 147° 00'00"W. longitude remained closed.

The guideline harvest level (GHL) of 825 tons was based on the preliminary 1997 spring spawning biomass forecast of approximately 34,000 tons and a harvest rate of 15 percent. There were twelve permit holders participating in the fishery and four processors had registered to buy bait herring. Of the four processors, two wanted a combined total of roughly 110 tons while the other two had larger markets to fill and would participate in the fishery until the quota was taken. While processors had expressed to the department and their permit holders a preference for a slow paced fishery, competition for fish between the two remaining processors served to quicken the pace of the harvest. By the morning of November 3, approximately 162 tons of quota remained to be harvested. A 2:00 p.m. closure was announced for that day which allowed the three remaining boats to make one last set prior to the closure. Approximately 270 tons were harvested on the final day and the total harvest was 109 tons over the guideline harvest level. The estimated value of the harvest is $187.000 with an average price of $200 per ton.

Pooled samples collected from the catch contained approximately 34 percent 2 year old fish. Four year old fish comprised approximately 19 percent and eight year old fish comprised 15 percent of the catch. The average fish weight was 129 grams and individual sample averages ranged from 105 to 163 grams. The strong showing of recruit classes in the harvest is encouraging with respect to the stock's recovery, however processors would have preferred a higher percentage of older aged fish in the harvest. Herring were readily accessible in the Montague Island area and harvesting commenced immediately when the fishery opened. Harvesting was not selective with respect to finding discreet concentrations of older aged fish and sets of over 100 tons were easily made. The large sets made by some of the participants resulted in excess fish being either bled off prior to, or released after, tenders had been filled. The practice in the bait fishery of capturing tonnage far in excess of tender capacity and releasing the excess after crowding, holding and pumping onto the tender may result in significant mortality through scale loss, stress, disease outbreaks and transmission. The length of seines allowed in the food and bait fishery may encourage this type of practice. Smaller seines, regulations restricting catching and releasing of bait herring, or reducing the quota to account for estimated dead loss are possible considerations for improving this fishery. The indirect removals are not reflected in the harvest figures for the fishery, yet they may make up a significant percentage of the total removed from the biomass each year.

1996-97 Herring Season Outlook

The management year for herring is from July 1 through June 30. In regulation, the guideline harvest level for all fisheries is established before the fall food-and-bait season and is based upon the final spawning biomass estimate from the previous spring, cohort analysis, and projected recruitment. In practice, the department has not been able to produce a final spring biomass estimate prior to the fall food-and-bait fishery. During the past several years, the fall food-and-bait fishery guideline harvest level was set based on a preliminary biomass estimate. The guideline harvest level for the spring fisheries are then set in early winter after a final analysis of available data is complete.

The herring forecast uses an Age Structured Analysis (ASA) model. The model incorporates previous spawn survey egg deposition estimates, the miles of spawn, growth, and age composition from the spawning stock and fishery harvests. Natural mortality is estimated by the ASA model whereas in prior years natural mortality was taken from the literature. The model hindcasted the 1996 spawning biomass at 27,500 tons. Accounting for growth and mortality the ASA model projects the 1997 spawning stock to be

37,600 tons. The spawning biomass should be dominated by herring aged-4, 5 and 9. At the forecasted stock size, all four PWS spring herring fisheries should also be able to proceed.

The trend over the past three years has been for a majority of the spawning population to school in the Montague Island area. Often during the prespawning period the majority of the herring in the area are concentrated in two or three large aggregations. With the relatively small quota for the sac roe seine fishery, having a majority of the population concentrated in a small area may make it difficult to remove the quota without overharvesting, even with very short, restrictive openings.

One of the two herring proposals before the Board seeks to allow open pounding to occur anywhere in PWS. The proposal would restrict open pounding in the Montague Island area until after the sac roe seine fishery is complete. The ongoing disease studies have strongly indicated that subjecting herring to stress such as confinement in pounds at high densities, can result in the expression of diseases, foster possible epidemics which can increase mortality in the general herring population. These factors, combined with the difficulty of measuring compliance with pound quotas and enforcing regulations on overharvesting, make open pounding a preferred alternative for this fishery. The department strongly endorses open pounding as the preferable gear configuration for the PWS fishery. The eventual elimination of closed pounds as an acceptable gear type may be in the best interest of the resource and the fishery. The department currently has emergency order authority to allow open pounding in areas other than the Northeast Shore area. If a low biomass of mature herring is all that returns to the traditional closed pounding areas, the department will likely not open the area to seining for introduction into pounds. If spawning is light in the area, open pounding may also be restricted. Clearly, unless the mature herring distribution within PWS changes by next spring, open pounding outside the Northeast Shore area may be the only opportunity that pound gear will have to participate in the fishery. The department intends to work with the herring pound permit holders to explain the current understanding of the disease problems in PWS's and Southeast's herring stocks, to define future research needs, and to explore options that will keep this fishery viable for the permit holders into the future.

FIGURES

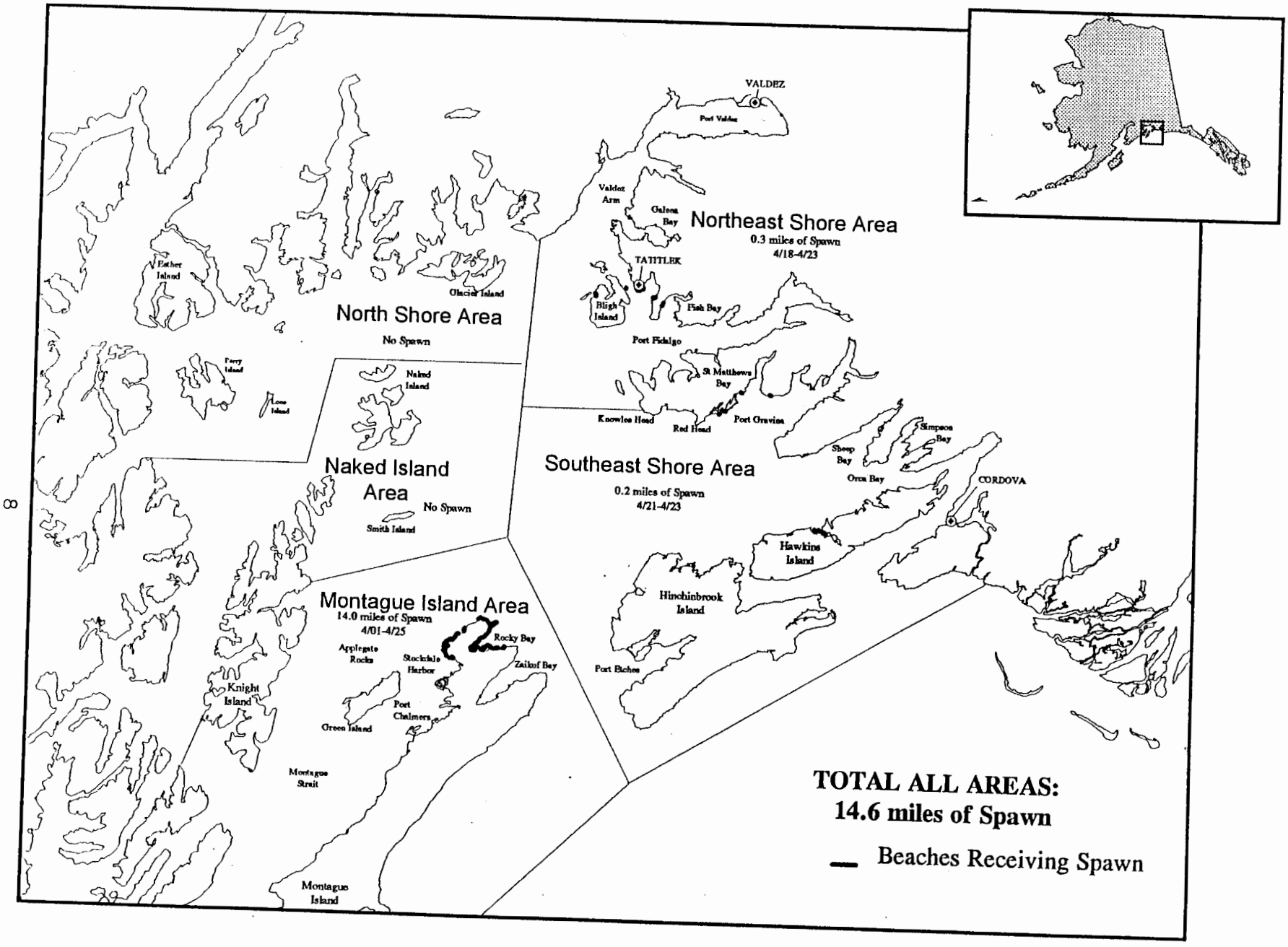

Figure 1. Prince William Sound herring spawn, shoreline mileage and dates of spawning mapped during aerial surveys, 1994.

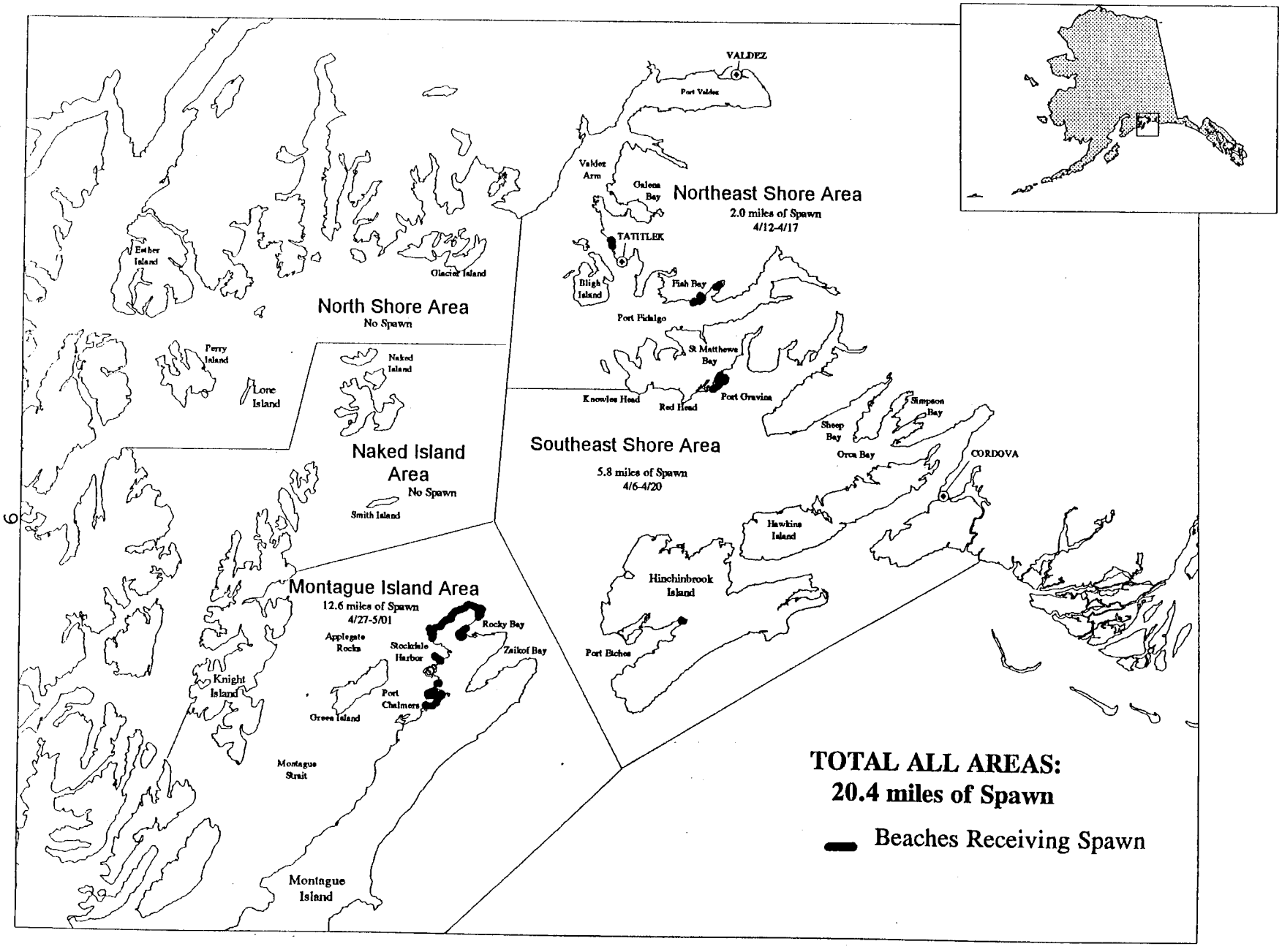

Figure 2. Prince William Sound herring spawn, shoreline mileage and dates of spawning mapped during aerial surveys, 1995.

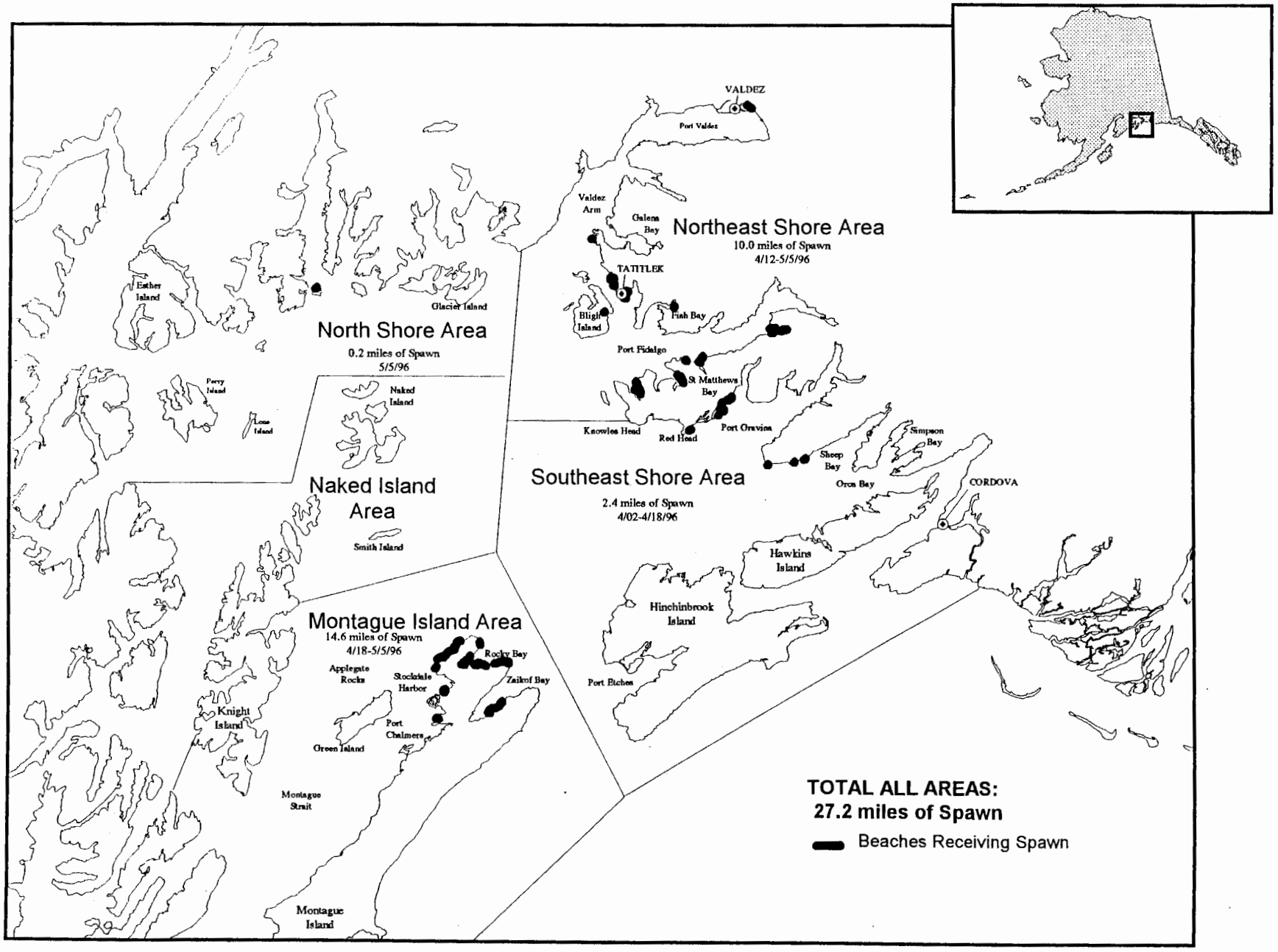

Figure 3. Prince William Sound herring spawn, shoreline mileage and dates of spawning mapped during aerial surveys, 1996.

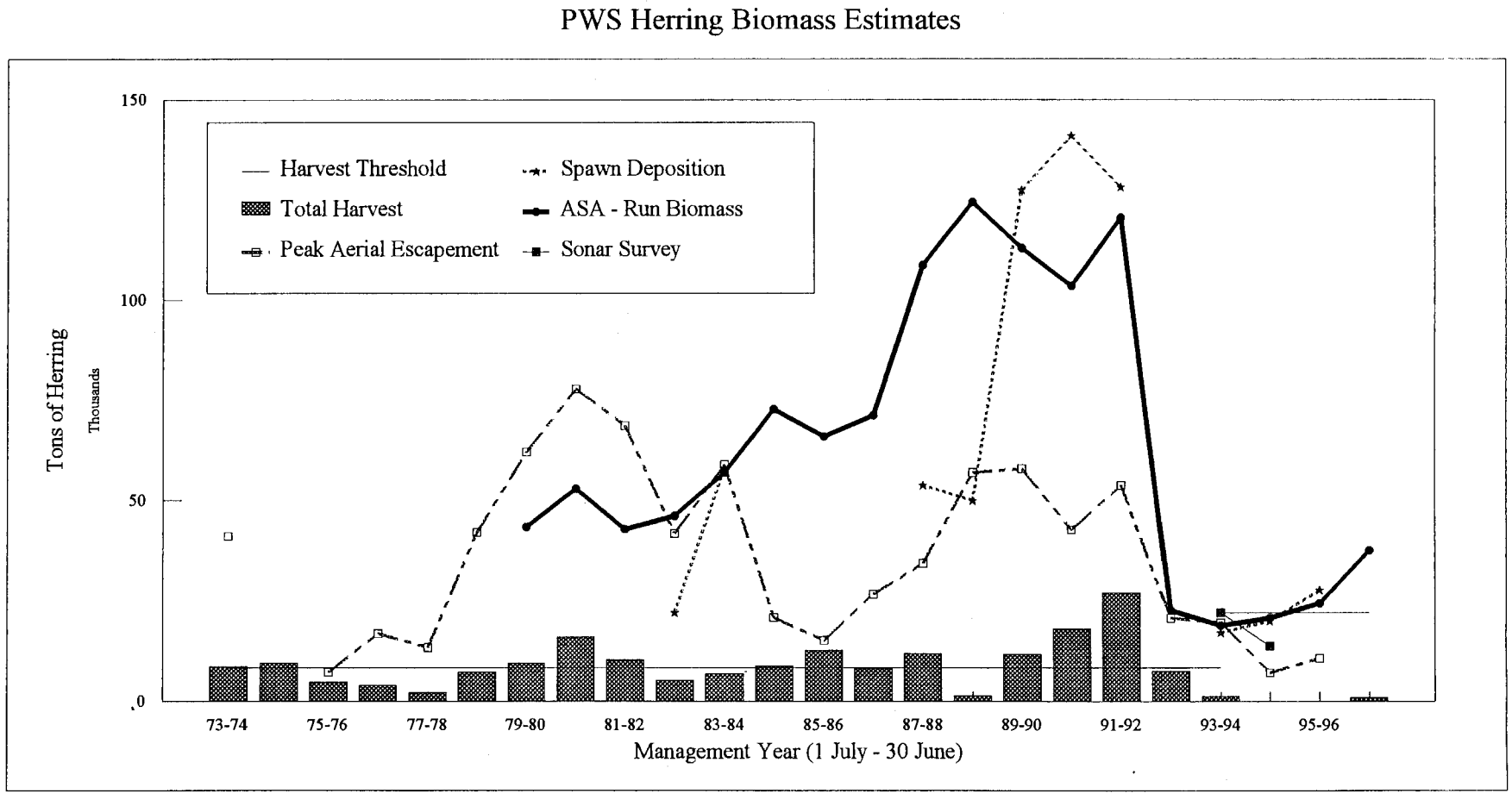

Figure 4. Prince William Sound annual herring biomass indices, harvest, and harvest threshold by management year, 1974-1997.

TABLES

Table 1. Commercial Pacific herring harvest summary with fishing location and effort by gear type, Prince William Sound, 1996.

Fishery	Fishing Information				Harvest and Use (tons)	
	Area	Date	Duration	Effort	Spawn on Kelp	Pacific Herring
Sac Roe Purse Seine	NO OPENINGS					
	Total					0.0
Sac Roe Gillnet	NO OPENINGS					
	Total					0.0
Wild Spawn-on-Kelp	NO OPENINGS					
	Total [a]					0.0 [b]
Pound Spawn-on-Kelp	NO OPENINGS					
	Total [c]					0.0 [d]
Food/Bait Fishery	Montague Is.	11/1-11/3	50 hours	6 boats		
	Total					933.9
Harvest and Use - Total						933.9

[a] The harvest of naturally occurring herring spawn on native kelp species in Prince William Sound.

[b] The biomass of herring subjected to removal of reproductive capacity of the population based on the assumptions that 10% of the biomass of pre-spawning herring consists of eggs and that 80% of the weight of harvested spawn on kelp consists of eggs.

[c] The harvest of herring spawn on kelp produced in net pens or pounds.

[d] The biomass of herring subjected to stress mortality and removal of reproductive capacity of the population based on the assumption that 12.5 tons of herring are used to produce one ton of spawn on kelp.

Table 2. Mean price and estimated exvessel value of the commercial Pacific herring harvest by gear type based on verbal post season estimates from processors and fishermen, Prince William Sound for calendar years 1978-1996.

	Sac Roe Fisheries				Spawn on Kelp Fisheries				Food-and-Bait Fishery		
	Purse Seine		Gillnet		Wild Spawn on Kelp		Pounds		Mixed Gear		
Calendar Year	Price per ton	Total Value	Price per ton	Total Value	Price per lb	Total Value	Price per lb [a]	Total Value	Price per ton	Total Value	TOTAL VALUE
1978	$720	$956,800		$0	$1.25	$175,000		$0	$380	$489,820	$1,621,700
1979	$1,260	$5,213,880		$0	$1.74	$821,280		$0	$300	$196,800	$6,231,960
1980	$320	$1,933,760		$0	$1.09	$667,080		$0	$300	$424,800	$3,025,640
1981	$400	$5,508,000	$580	$135,720	$1.00	$122,000		$0	$260	$328,120	$6,093,840
1982	$380	$2,716,240	$640	$251,520	$1.29	$397,320		$0	$220	$194,260	$3,559,340
1983	$600	$1,634,400	$1,040	$109,200	$2.10	$634,200		$0	$260	$70,980	$2,448,780
1984	$760	$4,435,360	$640	$218,880	NO HARVEST		$3.50	$176,439	$260	$265,460	$5,096,139
1985	$760	$5,380,800	$900	$371,700	$0.48	$19,200	$7.09	$569,058	$250	$279,500	$6,620,258
1986	$820	$8,058,960	$920	$412,160	$1.70	$159,800	$8.00	$1,155,200	$180	$229,680	$10,015,800
1987	$1,100	$5,480,200	$960	$511,680	$1.70	$299,200	$15.00	$1,836,000	$300	$356,700	$8,483,780
1988	$840	$6,600,000	$1,400	$537,000	$1.20	$232,000	$18.00	$4,500,000	$300	$400,590	$12,236,500
1989	SEASON CLOSED		SEASON CLOSED		SEASON CLOSED		SEASON CLOSED		$300	$193,830	$193,830
1990	$640	$5,351,744	$640	$323,456	$0.90	$213,840	$11.40	$2,305,080	$300	$605,130	$8,799,250
1991	$600	$7,153,800	$600	$445,200	$0.80	$172,160	$9.00	$2,880,000	$250	$1,064,625	$11,715,785
1992	$400	$6,713,680	$800	$752,480	$0.46	$232,116	$8.00	$3,875,200	$200	$780,060	$12,353,536
1993	NO HARVEST		$400	$411,960	$0.55	$178,860	$10.00	$2,000,000	$200	$217,400	$2,808,220
1994	SEASON CLOSED		SEASON CLOSED		SEASON CLOSED		SEASON CLOSED		SEASON CLOSED		$0
1995	SEASON CLOSED		SEASON CLOSED		SEASON CLOSED		SEASON CLOSED		SEASON CLOSED		$0
1996	SEASON CLOSED		SEASON CLOSED		SEASON CLOSED		SEASON CLOSED		$200	$186,600	$186,600

[a] The price per pound for spawn on kelp in pounds is based on the final product weight, not harvest weight.

Table 3. Pacific herring sac roe seine and gillnet fishery effort, anticipated and actual harvest, Prince William Sound, 1969 - 1996.

	Seine Fishery							Gillnet Fishery							Total
Calendar Year	Opening Dates	Hours	Effort (Boats)	Guideline Harvest [a]	Harvest (tons)	CPUE (tons/Boat Hr)	Estimated Roe %	Opening Dates	Hours	Effort (Boats)	Guideline Harvest [a]	Harvest (tons)	CPUE (tons/Boat Hr)	Estimated Roe %	Harvest (tons)
1969	3/01 - 6/30		5		325.4										355.7
1970	3/01 - 6/30														
1971	3/01 - 6/30		12		919.2										919.2
1972	3/01 - 6/30		18		1,777.2										1,777.2
1973	4/23 - 5/09		31		6,991.9										6,991.9
1974	4/10 - 4/17		72		6,371.0			4/10 - 04/17		3		3.8			6,374.8
1975	4/15 - 4/22	14.0	76		5,853.8	5.50			14.0						5,853.8
1976	5/08 & 6/01	13.0	66		2,584.2	3.01			13.0						2,584.2
1977	4/09 - 4/10	38.0	58		2,265.6	1.03		4/09 - 04/10	38.0	1		1.6	0.04		2,267.1
1978	4/17 - 4/21[b]	106.0	75	5,000	1,329.5	0.17		4/17 - 04/21	106.0	38		61.7	0.02		1,391.2
1979	4/07 - 4/19	215.5	89	5,000	4,138.0	0.22		CLOSED [c]							4,138.0
1980	4/01 - 4/09	162.0	76	5,000	6,042.2	0.49		4/17 - 5/05		16		264.4			6,306.7
1981	4/01 - 4/09	60.0	106	5,000	13,768.2	2.16		4/16 - 4/18	53.0	18		234.5	0.25		14,002.8
1982	4/23	2.0	95	5,000	7,148.3	37.62	10-14%	4/24 - 4/26	54.0	18		393.9	0.41	12-15%	7,542.2
1983	4/13	1.0	103 [d]	5,000	2,728.5	26.49	11.0%	4/21 - 4/22	24.0	22		105.4	0.20	11.0%	2,833.9
1984	4/14	3.0	105 [e]	5,000	5,946.1	18.88	10-11%	4/18 - 4/22	59.0	23	250	342.7	0.25	8-14%	6,288.8
1985	4/28 - 4/29	4.0	103 [f]	5,000	6,764.1	16.42	10-12%	4/29 - 5/01	34.0	21	250	413.3	0.58	10-12%	7,177.4
1986	4/17	3.0	106	5-7,000	9,828.1	30.91	11.0%	4/24 - 4/28	90.0	24	3-400	448.6	0.21	11.4%	10,276.7
1987	4/08 - 4/09	1.5	96	3-5,000	4,982.2	34.60	10.0%	4/10 - 4/11	24.0	24	2-300	533.3	0.93	9.5%	5,515.5
1988	4/21 - 4/22	2.0	105	4-5,000	7,977.3	37.99	10.5%	4/23	5.5	24	275	353.0	2.67	10.0%	8,330.3
1989 [g]	Season Closed			6,400							375				0.0
1990	04/12	0.3	96	6,038	8,362.1	290.35	10.0%	04/13	4.0	24	353	505.4	5.26	10.6%	8,867.5
1991	4/09, 4/10, & 4/19	1.3	104	11,233	11,923.0 [h]	85.32	10.5%	04/18	10.5	24	657	742.0	2.94	11.06%	12,665.1
1992	4/13, 4/17, & 4/21	2.0	104	14,100	16,784.2 [i]	80.25	10.0%	4/23 - 4/24	11.0	24	825	940.6	3.56	10.8%	17,724.8
1993	No Harvest			15,586				4/15, 4/17-4/19	36.0	24	912	1,029.9	1.19	11.01%	1,029.9
1994 [j]	Season Closed			0	151.0 [k]						0				151.0
1995 [j]	Season Closed			0							0				0.0
1996 [j]	Season Closed			0							0				0.0

[a] Guideline harvest based on pre-season harvest projections beginning in 1986.

[b] An additional opening on 6/14 for 6 hours resulted in no harvest.

[c] Gillnet fishery closed by Board of Fisheries action.

[d] Out of 103 boats participating, 72 actually made deliveries.
Out of 105 boats participating, 101 actually made deliveries.

[f] Out of 103 boats participating, 62 made deliveries at Montague Island and 90 made deliveries in the north-shore area.

[g] All Pacific herring commercial sac roe and spawn-on-kelp fisheries in Prince William Sound were closed during the spring of 1989 due to the potential for contamination of catches from the T/V Exxon Valdez oil spill.

[h] Total for 1991 includes a 92.2 ton test fishing set made by ADF&G for aerial survey calibration.

[i] Total for 1992 includes a 192.5 ton test fishing catch made by ADF&G for aerial survey calibration.

[j] Season closed due to low herring abundance.

[k] Harvest for 1994 consisted of a single a test fishing catch made by ADF&G for aerial survey calibration.

Table 4. Pacific herring spawn-on-kelp harvest produced in pounds, Prince William Sound, 1979 - 1996.

Year	Fishery Dates[a]	Effort			Guideline Harvest (tons)	Blades Per Permit Holder	Spawn-on-Kelp Harvest[b] (tons)			Herring Utilized (tons)[e]
		Permits Issued[b]	Pounds Built[c]	Producing Pounds[d]			Ribbon	Macrocystis	Total	
1979		2	0							
1980	4/14	14	4	2	8		0.9	0.4	1.3	16.6
1981	4/14	18	18	7	16		8.6	1.1	9.7	120.7
1982	4/29-5/10	25	20	18	26		25.1	0.5	25.5	319.2
1983	4/30-5/04	47	38	26	26		17.7	10.1	27.9	348.8
1984	4/24-5/08	65	45	37	26		6.4	18.8	25.8	322.8
1985	4/25-5/07	81	59	50	40		12.1	28.1	40.2	502.1
1986	4/21-4/28	104	82	81	60		0	72.2	72.2	903.0
1987	4/10-4/21	111	111	108	85		0	61.2	61.2	765.1
1988	4/12-4/23	122	122	119	85		0	123.2	123.2	1,540.5
1989	Season Closed[f]									
1990	4/11-4/26	128	128	122	118		0	98.8	98.8	1,235.3
1991	4/07-4/20	126	126	119	220	1,200	0	202.4	202.4	2,530.5
1992	4/07-4/24	127	127	127	276	1,770	0	242.2	242.2	3,027.7
1993	4/10-4/22	128	124	52	305	1,950	0	106.4	106.4	1,330.5
1994	Season Closed[g]									
1995	Season Closed[g]									
1996	Season Closed[g]									

a Dates that the fishery was opened to seines for the capture and placement of Pacific herring into pounds.

b Commissioner's permits issued to applicants on register prior to the March 1 deadline.

c Number of individual pounds constructed by the April 1 deadline, and consequently the number of individuals receiving an equal allocation of the guideline harvest.

d Number of pounds that were successful in producing spawn-on-kelp product. Due to the group cooperation in this fishery production is frequently reported for a few individuals whose pounds did not produce spawn-on-kelp product.

e The equivalent harvest of Pacific herring due to stress mortality and the removal of reproductive capacity of the population based on the assumption that 12.5 tons of Pacific herring are used to produce 1 ton of spawn-on-kelp product.

f All Pacific herring commercial sac roe and spawn-on-kelp fisheries in Prince William Sound were closed during the spring of 1989 due to the potential for contamination of catches from the T/V Exxon Valdez oil spill.

g Season closed due to low herring abundance.

Table 5. Pacific herring spawn-on-kelp harvests from natural spawning, Prince William Sound, 1969 - 1996.

Calendar Year	Fishery Dates	Hours	Effort (Divers)	Guideline Harvest (tons)	Harvest by Kelp Species and Grounds Price ($/lb)								Spawn-on-Kelp Harvest		Herring Utilized[a] (tons)
					Ribbon		Sieve		Fucus		Other				
					Percent	Price	Percent	Price	Percent	Price	Percent	Price	(lb)	(tons)	
1969	5/18-5/31		3										5,424	2.7	21.7
1970	4/19-6/06		34										190,374	95.2	761.5
1971	4/18-5/15		159										769,481	384.7	3,077.9
1972	4/30-5/20		397										600,453	300.2	2,401.8
1973	4/23-5/26		176										306,358	153.2	1,225.4
1974	4/22-5/04		143		Mostly Ribbon - Some Sieve and Hair				$0.60-0.75				580,588	290.3	2,322.4
1975	4/25-5/10		328										916,919	458.5	3,667.7
1976	4/21- ?		279										485,043	242.5	1,940.2
1977	4/27-12/31		104										417,000	208.5	1,668.0
1978	4/20-4/30		66	165	23%		50%				27% [b]		141,268	70.6	565.1
1979	4/25-5/03		97	200									474,242	237.1	1,897.0
1980	4/23-4/30	10	458	200	60%	$1.25	40%	$0.85					603,880	301.9	2,415.5
1981	4/25	12	196	200	38%	$1.25	60%	$0.85			2% [b]	$0.60	122,532	61.3	490.1
1982	5/05-5/08	73	152	187	83%	$1.42	11%	$0.95			6% [b]	$0.74	291,430	145.7	1,165.7
1983	4/27	12	185	187	51%	$2.00-2.45	35%	$1.50-1.70			14% [c]		298,362	149.2	1,193.4
1984	Season Closed [d]		225 [e]	187											
1985	5/06 & 5/08	20	106	169	51%	$1.25	49%	$0.50					60,832	30.4	243.3
1986	4/30-5/03	86	29	142	97%	$1.75		$0.80			[b]	$0.80	95,205	47.6	380.8
1987	4/15-4/17	44	59	103	90%	$1.70		$0.85			[b]	$0.80	176,485	88.2	705.9
1988	4/29 & 4/30	12	159	103	64%	$1.50	24%	$0.75-1.00			12% [b]	$0.75-1.00	194,762	97.4	779.0
1989	Season Closed [f]			110											
1990	4/21-4/22	16	134	104	37%	$0.99	6%	$0.52			57% [b]	$0.88	237,575	118.8	950.3
1991	5/11-5/17	95	48	195					100%	$0.75-0.85			215,147	107.6	860.8
1992	4/24-4/30	101	217	243	21%	$0.70			76%	$0.40	3%		504,663	252.3	2,018.7
1993	4/19-4/24	114	83	268					100%	$0.55			325,181	162.6	1,300.7
1994	Season Closed [g]			110											
1995	Season Closed [g]			0											
1996	Season Closed [g]			0											

[a] Indicates the annual removal of reproductive capacity from the population based on the assumption that average fish roe recovery is 10% and 80% of spawn-on-kelp harvest weight consists of eggs.

[b] Hair kelp.

[c] Mostly Macrocystis spp. Some hair kelp.

[d] Season remained closed due to lack of suitable spawn.

[e] Permits issued.

[f] All Pacific herring commercial sac roe and spawn-on-kelp fisheries in Prince William Sound were closed during the spring of 1989 due to the potential for contamination of catches from the T/V Exxon Valdez oil spill.

[g] Season remained closed due to low herring abundance.

Table 6. Prince William Sound commercial Pacific herring food/bait fishery effort and harvests, management years 1969-1996

Management Year	Fishing Dates Opened	Fishing Dates Closed	Guideline Harvest	Purse Seine Effort (Boats)	Purse Seine Harvest (tons)	Pair Trawl Effort (Boats)	Pair Trawl Harvest (tons)	Mid-Water Trawl Effort (Boats)	Mid-Water Trawl Harvest (tons)	Otter Trawl Effort (Boats)	Otter Trawl Harvest (tons)	Total Harvest (tons)
1969-1970	10/01/69	06/30/70 [a]		-	14.0							14.0
1970-1971	10/01/70	06/30/71 [a]										0.0
1971-1972	10/01/71	06/30/72 [a]		-	20.0							20.0
1972-1973	10/01/72	05/09/73 [a]		-	9.0							9.0
1973-1974	08/27/73	04/17/74 [a]	[b]	-	8.5							8.5
1974-1975	07/15/74	03/10/75	[b]									0.0
1975-1976	06/01/75	06/25/75 [c]	[b]	4	226.7							226.7
1976-1977	02/01/77	03/09/77	[b]									0.0
1977-1978	10/01/77	02/28/78	[b]	-	17.0	-	145.3					162.3
1978-1979	10/16/78	? [d]	[b]	-	195.4	7	988.7	-	9.4	-	81.0	1,274.4
1979-1980	09/16/79	02/28/80 [e]	1,400	-	510.8	4	145.1	-	103.2	-	2.6	761.7
1980-1981	09/15/80	11/07/80	1,400	-	1,030.4	6	275.7					1,306.1
1980-1982	09/15/81	09/30/81	1,400	7	1,189.4	-	73.1					1,262.5
1982-1983	09/15/82	01/31/83	1,400	6	797.3							797.3
1983-1984	09/15/83	01/31/84	1,400	-	257.6							257.6
1984-1985	09/15/84	01/31/85	1,400	-	936.2							936.2
1985-1986	09/01/85	02/15/86	1,400	6	1,118.1							1,118.1
1986-1987	09/01/86	10/24/86	1,400	6	1,276.2							1,276.2
1987-1988	09/02/87	11/12/87 [f]	1,400	7	1,189.4							1,189.4
1988-1989	11/01/88	11/05/88	1,400	8	1,335.3							1,335.3
1989-1990	11/01/89	01/31/90	1,694	-	646.1							646.1
1990-1991	09/21/90	11/24/90 [g]	3,151	5	1,955.0			-	60.8			2,015.9
1991-1992	10/01/91	10/14/91	3,956	14	4,258.5							4,258.5
1992-1993	10/01/92	10/22/92	3,416 [h]	17	3,900.3							3,900.3
1993-1994	10/07/93	10/10/93	978 [i]	8	1,087.0							1,087.0
1994-1995	Season Closed [j]											0.0
1995-1996	Season Closed [j]											0.0
1996-1997	11/01/96	11/03/96	825	6	933.9							933.9

[a] Openings set by regulation. Ending date coincides with regulatory ending of sac roe season.

[b] No Official quota, but unofficial goal was 1,500 tons.

[c] Harvest from special June food-and-bait fishery opening. Although this harvest actually occurred at the end of the 1975 management year, it is included in the 1976 harvest management year to be consistent with other food-and-bait harvests which occur after spring sac roe fisheries.

[d] Fishery closed from 1 January to 6 January 1979.

[e] Fishery closed from 1 January to 15 February 1980.

[f] Fishing season opened by regulation on September 1, 1987 in the General District. The north-shore and east-shore Pacific herring districts opened on September 23. The season was closed by emergency order on October 6 for a period of five weeks, reopened on November 9, and closed for the duration of the 1987-88 season on November 12, 1987.

[g] Fishery open from September 21 until November 24. The Montague Island area was open from September 24 until November 24.

[h] Preseason guideline harvest level based on spawn deposition biomass estimate. Final guideline harvest based on age-structured analysis was issued in January 1993 and was 4,373 tons.

[i] Preseason guideline harvest level based on preliminary aerial survey biomass estimate of 40,000 tons.

Table 7. Annual Pacific herring biomass indices, Prince William Sound, for herring management years 1974-1996 and the forecast of prefishery run biomass for 1997.

Management Year	Total Sac Roe Harvest [a] (tons)	Aerial Survey Estimates				Unexploited Escapement Biomass		Pre-Fishery Run Biomass
		Peak Biomass Estimate [b] (tons)	Maximum Possible Observed Biomass [c]	Miles of Spawn [d]	Mile Days of Spawn [e]	Spawn Deposition Surveys [f] (tons)	Age Structured Analysis (tons)	Age Structured Analysis (tons)
1973-1974	6,374.8	41,080	107,290	38.5	75.2			
1974-1975	5,853.8			34.2	42.4			
1975-1976	2,584.2	7,330	25,247	32.8	33.7			
1976-1977	2,267.1	16,830	17,460	39.3	73.5			
1977-1978	1,391.2	13,410	36,540	28.7	36.3			
1978-1979	4,138.0	42,100	107,390	54.5	73.2			
1979-1980	6,306.7	62,110	122,050	50.5	73.9		27,628.3	43,401.3
1980-1981	14,002.8	77,810	161,690	85.4	140.1		25,296.9	52,989.1
1980-1982	7,542.2	68,790	97,620	49.0	65.1		22,731.8	42,903.0
1982-1983	2,833.9	41,850	107,710	67.4	99.8	22,000 [g]	30,407.2	46,196.7
1983-1984	6,288.8	58,870	158,760	60.1	86.8	58,089	38,157.6	57,022.5
1984-1985	7,177.4	20,830	60,954	101.2	149.5		49,899.4	72,695.1
1985-1986	10,276.7	15,180	54,820	72.4	152.3		41,541.7	65,971.0
1986-1987	5,515.5	26,580	52,192	65.3	155.9		52,462.2	71,156.3
1987-1988	8,330.3	34,270	67,175	166.3	236.9	53,785	84,199.9	108,671.2
1988-1989	[h]	56,915	186,708	98.4	185.8	49,914	107,616.3	124,465.1
1989-1990	8,867.5	57,900	145,013	94.1	144.4	127,478	98,289.7	112,998.9
1990-1991	12,665.1	42,765	141,375	58.0	64.8	140,964	97,466.3	103,548.8
1991-1992	17,724.8	53,835	130,569	74.7	99.5	128,263	130,100.1	120,657.8
1992-1993	1,029.9	20,725	109,865	20.4	40.8		18,145.1	22,634.8
1993-1994 [i]	0.0	19,640	154,008	14.6	20.0	17,069	18,420.7	18,852.8
1994-1995 [i]	0.0	7,113	20,868	20.4	32.3	20,022	20,639.7	20,639.7
1995-1996	0.0	10,691	37,771	27.2	39.1	27669	24,332.4	24,332.4
1996-1997 [j]								**37,598.0**

[a] Represents the combined common property seine and gillnet sac roe harvest in short tons.

[b] Largest single day aerial estimate of Pacific herring biomass in short tons.

[c] The sum of all daily aerial biomass estimates for a given year.

[d] Total linear miles of spawn.

[e] The sum of the daily observed linear miles of Pacific herring spawn.

[f] Estimates are made from underwater surveys of spawn deposition.

[g] Partial estimate of spawning biomass from feasibility study.

[h] All Pacific herring commercial sac roe and spawn-on-kelp fisheries in Prince William Sound were closed during the spring of 1989 due to the potential for contamination of catches from the T/V Exxon Valdez oil spill.

[i] Unexploited escapement and run biomass estimates from age structured analysis, November 1995.

[j] Forecast from age structured analysis, November 1996.